

We claim:

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1. A crosslinker for organic coatings, comprising the reaction product of
    - (a) an amino resin comprising reactive groups selected from the group consisting of alkoxyalkyl, alkylol, and mixtures thereof;
    - 5 (b) an olefinically unsaturated compound having a functional group reactive toward the reactive groups on the amino resin; and
    - (c) a silicon-containing compound having a functional group reactive toward the reactive groups on the amino resin.
  2. A crosslinker according to Claim 1, wherein the amino resin comprises a melamine formaldehyde resin.
  3. A crosslinker according to Claim 2, wherein the melamine formaldehyde resin has a number average molecular weight of up to about 2000.
  4. A crosslinker according to Claim 1, wherein the olefinically unsaturated compound comprises one or more compounds selected from the group consisting of hydroxyl-functional olefins, hydroxyalkyl esters of unsaturated carboxylic acids, amino-functional olefins, and hydroxyalkyl  
5 amides of unsaturated carboxylic acids.

4 13. A coating composition, comprising  
one or more organic resins comprising functional groups reactive  
toward alkoxyalkyl groups or alkylol groups; and  
a crosslinker composition comprising  
5 at least one functionalized crosslinker comprising  
an amino resin core; and  
as substituents on the core:  
one or more olefin functional groups;  
at least one silicon-containing group; and  
10 at least one group selected from the group consisting  
of alkoxyalkyl, alkylol, and mixtures thereof.

5 14. A coating composition according to claim 13, wherein the  
crosslinker composition further comprises a second crosslinker different from  
the functionalized crosslinker and comprising a plurality of functional groups  
reactive toward at least some of the functional groups on the one or more  
5 organic resins, in such amounts that from about 0.1% to about 20%, on an  
equivalent basis, of the resin reactive functional groups of the crosslinking  
composition are contributed by the functionalized crosslinker.

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A3 15. A crosslinking composition according to Claim 14, wherein 0.1 -  
10%, on an equivalent basis, of the resin reactive functional groups in the  
crosslinking composition are contributed by the functionalized crosslinker.

9 18. A method of preparing a cured coating, comprising the steps of:  
applying onto a substrate a coating composition comprising one  
or more curable resins having reactive functional groups and one or more  
crosslinking agents having functional groups which are reactive with those of  
5 the resins;

curing the applied mixture thermally; and

curing the applied mixture with ultraviolet radiation;

wherein the crosslinking agents include at least a first crosslinking agent  
comprising a reaction product of

10 (a) an amino resin comprising reactive groups selected from  
the group consisting of alkoxy alkyl, alkylol and mixtures thereof.

(b) an olefinically unsaturated compound having a functional  
group reactive toward the reactive groups on the amino resin; and

(c) a silicon-containing compound having a functional group  
15 reactive toward the reactive groups on the amino resin.

10 19. A method according to Claim 18, wherein the amino resin  
comprises a melamine formaldehyde resin.

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A4 20. A method according to Claim 18, wherein the melamine  
formaldehyde resin has a molecular weight of up to about 2000.

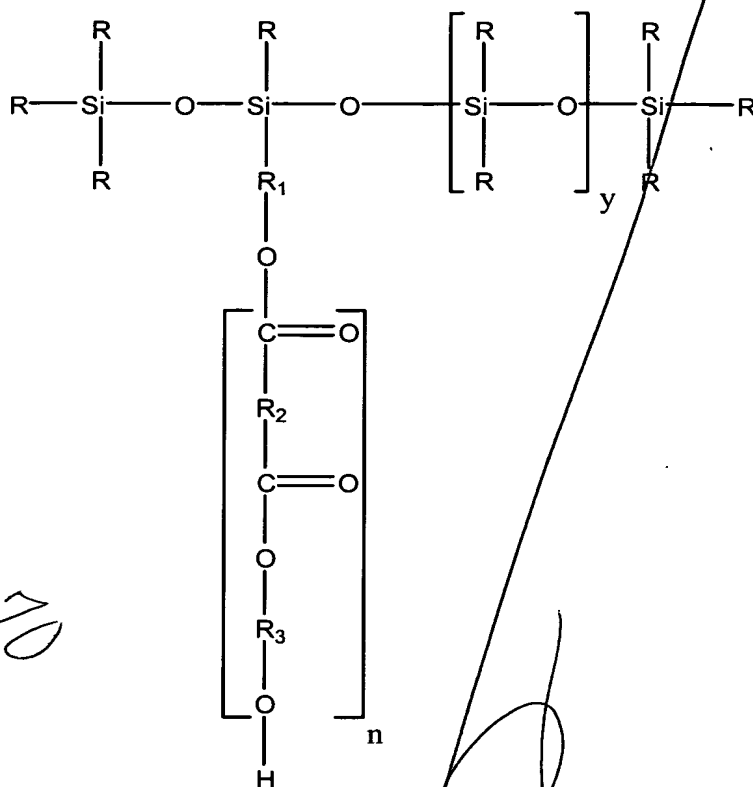
12 ~~21~~. A method according to Claim <sup>9</sup>~~18~~, wherein the olefinically  
unsaturated compound comprises one or more compounds selected from the  
group consisting of hydroxyl-functional olefins, hydroxyalkyl esters of  
unsaturated carboxylic acids, amino-functional olefins, and hydroxyalkyl  
5 amides of unsaturated carboxylic acids.

13 ~~22~~. A method according to Claim <sup>12</sup>~~21~~, wherein the olefinically  
unsaturated compound comprises one or more hydroxyalkyl esters of acrylic  
or methacrylic acid.

14 ~~23~~. A method according to Claim <sup>9</sup>~~18~~, wherein the silicon containing  
compound comprises a silicon atom to which an alkyl chain is attached, said  
alkyl chain being substituted with a functional group reactive toward an  
alkoxymethyl group.

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<sup>15</sup>~~24~~. A method according to Claim <sup>9</sup>~~18~~, wherein the silicon containing compound comprises a compound of structure



5 where the R groups are each independently C<sub>1</sub>-C<sub>20</sub> alkyl or aryl groups; R<sub>1</sub> is a C<sub>1</sub>-C<sub>20</sub> bridging group; y is 0 or greater; R<sub>2</sub> and R<sub>3</sub> are each independently selected from the group consisting of C<sub>2</sub>-C<sub>6</sub> alkylene, benzene-1,2-diyl, benzene-1,3-diyl, and benzene-1,4-diyl; n is 1 or greater, and the hydroxyl number is from about 10 mg KOH/g up to about 200 mg KOH/g.

<sup>16</sup>~~25~~. A method according to Claim <sup>9</sup>~~18~~, wherein the thermal curing step and the ultraviolet curing step are carried out simultaneously.

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26. A method according to Claim 18, wherein the thermal curing step is started before the ultraviolet curing step.

27. A method of preparing a cured coating, comprising the steps of:  
applying a composition to a substrate to form an uncured coating having a bulk liquid portion and a liquid to air interface;  
curing the coating thermally; and  
curing the coating with ultraviolet radiation,  
wherein the composition contains a component which is ultraviolet curable and thermally curable, and wherein the concentration of the component is greater in the liquid to air interface than in the bulk liquid portion of the uncured coating.

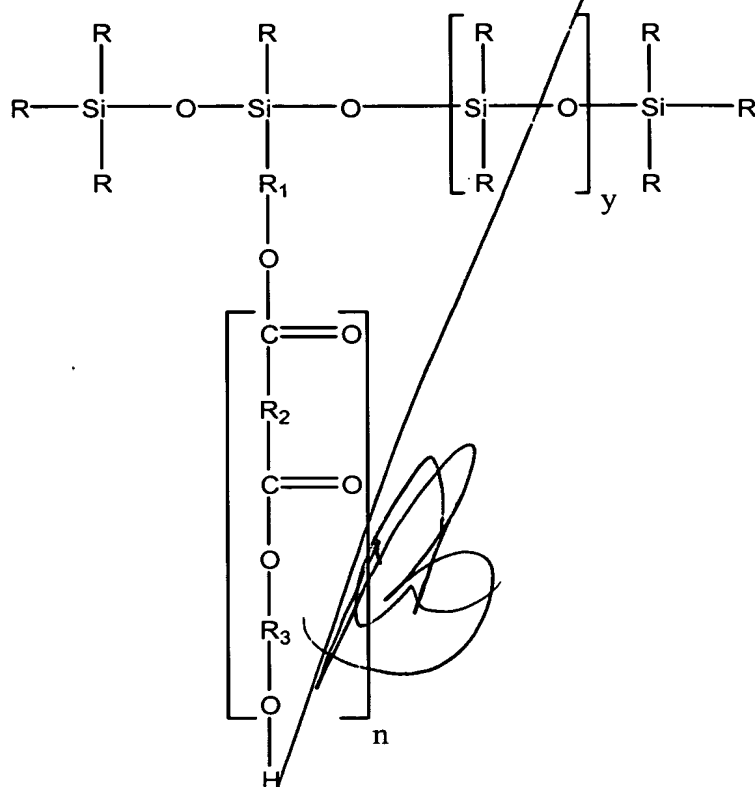
28. A method according to Claim 27, wherein the thermal curing step is started before the ultraviolet curing step.

29. A method according to Claim 27, wherein the thermal curing step and the ultraviolet curing step are carried out simultaneously.

6. A crosslinker according to Claim 5, wherein the olefinically unsaturated compound is selected from the group consisting of hydroxyethyl acrylate, hydroxyethyl methacrylate, hydroxypropyl acrylate, hydroxypropyl methacrylate, and mixtures thereof.

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8. A crosslinker according to Claim 1, wherein the silicon-containing compound comprises a compound of structure



5 where the R groups are each independently C<sub>1</sub>-C<sub>20</sub> alkyl or aryl groups; R<sub>1</sub> is a C<sub>1</sub>-C<sub>20</sub> bridging group; y is 0 or greater; R<sub>2</sub> and R<sub>3</sub> are each independently selected from the group consisting of C<sub>2</sub> - C<sub>6</sub> alkylene, benzene-1,2-diyl, benzene-1,3-diyl, and benzene-1,4-diyl; n is 1 or greater, and the hydroxyl number is from about 10 mg KOH/g up to about 200 mg KOH/g.



9. A crosslinker according to Claim 1, comprising 2 or more olefin functional groups.

10. A crosslinker for organic coatings, comprising:  
an amino resin core; and  
as substituents on the melamine core --

one or more olefin functional groups;  
at least one silicon-containing group; and  
at least one group selected from the group consisting of  
alkoxyalkyl, alkylol, and mixtures thereof.

11. A crosslinker according to Claim 10, wherein the substituents on the melamine core comprise more than one olefin functional group.

12. A crosslinker according to Claim 10, wherein the substituents on the melamine core comprise two or more olefin functional groups.

16. A crosslinking composition according to Claim 14, wherein from 0.1 to 3%, on an equivalent basis, of the resin reactive functional groups in the crosslinking composition are contributed by the functionalized crosslinker.

17. A crosslinking composition according to Claim 14, wherein the functionalized crosslinker has two or more olefin functional groups.

30. A method according to Claim 27, wherein the composition applied to the substrate contains a component comprising

an amino resin core; and

as substituents on the core,

5 more than one olefin functional group,

at least one silicon-containing group, and

at least one group selected from the group consisting of

alkoxyalkyl, alkylol, and mixtures thereof.

31. A method according to Claim 27, wherein the ultraviolet curable component comprises the reaction product of

- (a) an amino resin comprising reactive groups selected from the group consisting of alkoxyalkyl, alkylol, and mixtures
- 5 (b) an olefinically unsaturated compound having a functional group reactive toward the reactive groups of the amino resin;
- (c) a silicon-containing compound having a functional group reactive toward the reactive groups of the amino resin.